PATENT SPECIFICATION

821,330

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International Classification:—B62d.

COMPLETE SPECIFICATION

DRAWINGS ATTACHED

Improvements in Trailers

I, JOHN PHIL FELLABAUM, a citizen of the United States of America, of 124 East Thruston Boulevard, City of Tayton, County of Mongomery, State of Ohio, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a transportation trailer, more particularly to trailers of the general class which includes semi-trailers.

It has long been recognized that spacing the load bearing axles longitudinally of the vehicle permits carrying maximum loads with minimum road damage. However, prior art attempts to employ widely spaced tandem axles on semi-trailers have been relatively unsuccessful for one or more of the following reasons:

Firstly, attempts to merely spread the usual non-steerable tandem axles apart have resulted in semi-trailers which have been difficult to handle on curves and which have been extremely severe on tires. When negotiating a turn or curve with a trailer having this type construction, the trailer tires are dragged sideways so severely that a very noticeable braking effect is produced. As will be apparent, tire mileage on anything other than relatively straight roads is quite poor. Moreover, this induced tire scuffing on turns or curves is particularly dangerous during slippery weather since there is a greater tendency for the trailer to skid out of control.

Secondly, attempts to caster one or more of the semi-trailer axles or to otherwise mount them so that they trail or align themselves with the direction of trailer movement has resulted in trailers which have been difficult, if not veritably impossible, to maneuver in backing. Moreover, since the wheels merely follow the direction of trailer movement, they do not contribute to the trailer's stability.

In the third place, attempts to positively steer the wheels carried by one or more of the semi-trailer's axles in response to angular displacement between the respective longitudinal axes of the semi-trailer and the towing vehicle, or tractor, have operated with a certain degree of success. However, constructions of this type have not achieved wide usage primarily because of high initial cost, excessive maintenance requirements, and excessive weight.

The invention consists in a trailer having two sets of wheels spaced from each other with the front set of wheels mounted on an axle which is mounted in the trailer so as to be capable of both a pivotal movement and a limited longitudinal movement relative to the trailer, said axle having connected thereto on opposite sides of its pivotal mounting in the trailer the rear ends of a pair of steering rods, the forward ends of which are connectable to the tractor symmetrically on opposite sides of the vertical axis which is located at the rear end of the tractor and about which the trailer is pivotally connectable with the tractor.

Referring now to the accompanying drawings, in which:

Figure 1 is a fragmentary side elevational view of a semi-trailer constructed in accordance with the present invention and connected for operation with a suitable tractor. the road wheels on the side facing view being removed in the interest of clarity;

Figure 2 is a top plan view of the structure shown in Figure 1, the bed of the trailer being removed to better illustrate the underlying construction;

Figure 3 is an enlarged, fragmentary perspective view of the sub frame;

Figure 4 is an enlarged, fragmentary sec-

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tional view generally corresponding to the line 4-4 of Figure 1;

Figure 5 is a fragmentary sectional view generally corresponding to the line 5-5 of Figure 4, and

Figure 6 is a reduced size generally diagrammatic view showing the tractor and the trailer negotiating a turn.

As best seen in Figures 1 and 2, the present invention is herein shown applied to a trailer 10 (commonly known as a semi-trailer) whose forward portion 11 is adapted to be supported by a suitable tractor 12 to which it is pivotally secured by the usual fifth wheel assembly 13. As in conventional constructions, the fifth wheel assembly 13 comprises a fifth wheel plate 14 secured to the frame 15 of the tractor and upon which the forward portion 11 of the trailer rests. The assembly further comprises a king pin 16 (see Figure 2) carried by the trailer and cooperable with the fifth wheel plate to provide a generally vertical axis about which the respectiv longitudinal axes of the tractor and the trailer may be angularly displaced.

Since the tractor herein disclosed is of conventional design, it has not been shown in its entirety; however, it is to be understood that it has the usual front, steerable wheels, a suitable engine, and rear drive wheels 17. Note that the frame 15 of the tractor extends rearwardly of the drive wheels 17 to permit the latter to be resiliently connected to the frame by means of suitable springs (not shown).

As pointed out, the forward portion 11 of the trailer is adapted to be supported by the tractor while the rear portion of the trailer is supported by wheels carried by respective axles 18, 19 spaced apart longitudinally of the trailer. As will be apparent, the spacing between the axles 18, 19 is considerable so that each axle can carry its maximum load.

In the present embodiment and with respect to the longitudinal axis of the trailer, axle 18 is fixed while axle 19 is steerable. Any suitable means may be employed to maintain axle 18 in fixed relation relative to the trailer axis, the construction herein disclosed employing conventional radius rods 20, each having one end pivotally secured to the axle and each having the other end pivotallv secured to respective longitudinally extending frame members 21, 21 of the trailer

Disposed adjacent frame members 21, 21 and positioned outboard of the latter for increased stability are a pair of supporting leaf springs 22, 22 whose center portions are secured to axle 18 by any suitable means The rear portion of each leaf spring 22 is engageable with a slip shackle 23 carried by respective frame members 21 while the front portion of each is engageable with a slip shackle 24 carried by the rear portions of respective spaced-apart arm members 25 of a sub frame or walking beam assembly 26. Arms 25 are pivoted to the trailer about the axis of a rock shaft 27 carried by depending brackets 28 secured to respective frame members 21 and each arm is independently shiftable about the axis of the rock shaft. In a manner to be disclosed hereinafter, the forward portions of arms 25 are adapted to support the steerable axle 19.

Since the rear portions of arms 25 are engageable with respective springs 22 positioned outboard of frame members 21, the rear portions of the arms are also preferably positioned outboard of the frame members. In the present embodiment, it is preferable to reduce the overall height of the trailer by positioning the forward portions of arms 25 as close as possible to axle 19. This necessitates that the forward portions of the arms converge so as to fit between the axially spaced wheels carried by axle 19 to permit steering of the axle. Such convergence also permits the arms to fit between the frame members 21 to allow maximum movement of the arms about the axis of rock shaft 27.

The construction for connecting the forward portions of arms 25 with steerable axle 19 may best be seen in Figures 4 and 5. As therein ilustrated, a flat plate 29 extends between the front portions of the arms 25 for a purpose to be disclosed hereinafter and, in the present embodiment, blocks 30, formed of rubber or other suitable resilient material. are interposed between each of the arms 25 and the plate 29 in order to provide for a certain amount of flexibility therebetween.

Means are provided for maintaining plate 29 and blocks 30 in assembled relation with arms 25 and, as most clearly shown in Figure 5, the front of each arm 25 has a hook shaped bracket 31 secured thereto by means of bolts 32 and interlocked with an angle bracket 33 welded or otherwise secured to the front portion of plate 29. In a similar manner, the rear of plate 29 is attached to respective arms 25, 25 by hook shaped brackets 34 and angle brackets 35. Note that each bracket 31, 33, 34 and 35 has a portion which engages an adjoining edge of its respective block 30 to maintain the block in fixed position between the plate 29 and respective arms 25.

Referring to Figure 4, brackets 36, 37 are shown secured by welding or the like to plate 29 on opposite sides of blocks 30 to form respective channels for receiving the blocks. and secured to arms 25 are brackets 38 and 39 which also form respective channels for the blocks. From the foregoing, it will be clear that plate 29 is resiliently secured across arms 25 by interposing the resilient blocks 30 therebetween, the blocks being confined by abutments which prevent displacement thereof.

A generally circular plate 40 is affixed by

welding or the like to axle 19, the upper surface of plate 40 being adapted to seat against the lower surface of plate 29 (see especially Figures 3, 4 and 5). A centrally located upstanding pin 41 is carried by plate 40, the pin passing through a slot 42 formed in plate 29. Pin 41 forms an axis about which axle 19 is steerable, whereas slot 42 permits a certain amount of axle movement longitudinally of the trailer for a purpose to become clear. Although not shown, suitable means may be provided to prevent separation of the plates 29, 40. However, the weight of the trailer will normally hold the plates together and render such additional structure unnecessary.

Link means are provided for steering axle 19 in response to relative angular displacement between the respective longitudinal axes of the tractor and the trailer and such means is herein shown to comprise rods 43, 44, whose rear ends are pivotally connected to axle 19 on opposite sides of the axis provided by pivot pin 41 and whose front ends are pivotally connected to the tractor on opposite sides of king pin 16 and preferably at respective points spaced rearwardly of the king pin. Any suitable arrangement may be employed to effect the pivoted connections of rods 43, 44; however, it is contemplated that such pivots be mounted in rubber to absorb road shocks and to compensate for slight misalignment.

With the construction disclosed, it will be apparent that, since axle 19 floats in slot 42 of plate 29, the axle will be drawn by the tractor during forward movement through rods 43, 44 and pushed by the tractor during rearward movement.

Before describing operation of the herein disclosed vehicle in travelling a non-rectilinear path, operation of the vehicle in passing over an obstruction will be disclosed Assuming that the wheels on one end of axle 19 strike an obstruction, such axle end will be driven upwardly. This will cause the adjoining arm 25 to rotate about the axis of rock shaft 27 and, via the spring 22 connected to this arm, force the corresponding end of axle 18 downwardly to thereby equalize wheel movement. Because of the resilient mounting between arms 25 and plate 29. arms 25 may move more or less independently to provide a medium of independent wheel action and thus reduce the shock imparted to the trailer. It will be clear that in the event the wheels carried by one end of axle 18 strike an obstruction, axle 19 will be forced downwardly by a reversal of the above described action.

From the foregoing it will be evident that only two springs 22 are employed for springing both axles 18 and 19. This is an important factor in reducing the weight of the running gear and consequently the weight of the trailer.

It will be noted that rotation of arms 25 about the axis of the rock shaft 27 will cause the forward portion of the arms to rotate through an arc while axle 19, supported by the forward ends of the arms, is held in generally fixed position relative to the axis of the trailer by means of the fixed length rods 43, 44. For this reason, and for another hereinafter to appear, pin 41, carried by axle 19, is shiftable longitudinally of arms 25 in the slot 42 provided in plate 29.

With particular attention to Figure 6, operation of the vehicle herein disclosed in negotiating a turn will be as follows: When the tractor 12 and the trailer 10 are moving in a straight line, their respective longitudinal axes coincide; however, when the tractor is turned, for example to the left as illustrated in Figure 6, such axes will rotate relative to each other about the generally vertical axis provided by king pin 16 of the fifth wheel assembly 13. As the tractor turns, the portion of its frame 15 spaced rearwardly of the fifth wheel and to which the forward ends of rods 43, 44 are secured will swing in an arc about the fifth wheel assembly.

During initial turning movement, rod 44 will pull the end of axle 19 to which it is connected forward whereas rod 43 will push the other end of axle 19 rearward. This will cause the axle to rotate about pivot pin 41 to thus effect steering thereof. As a sharper turn is made, the forward end of rod 43 will cross over the center of draft, or longitudinal axis of the trailer (as indicated in Figure 6). When this occurs, both rods 43 and 44 will exert a forward pull on axle 19; however, because of its position on the arc about which it is turning, the forward pivot of rod 44 will move forward at a greater rate than will that of rod 43. Therefore, axle 19 will be rotated even further and, at the same time, will be pulled forward.

As hereinbefore mentioned, the present invention sacrifices a certain amount of steering accuracy, particularly at sharp turning radiuses, in the interest of practicality. By way of illustration, when negotiating a turn which requires that the axis of the tractor be disposed at the 30 degree angle shown relative to the axis of the trailer and wherein the vehicle will thereupon be turning about center A, the centerline of axle 19 should point directly toward this center if all tire slippage is to be eliminated. However, with the present arrangement of parts, axle 19 will not quite be turned sufficiently to align with this center but will be approximately fifty-three minutes short.

Since the wheels carried by axle 19 and those carried by axle 18 are substantially equally loaded, there will be a tendency for any turning error to be evenly shared by the two axles. Accordingly, each axle 18, 19 will,

in effect, be misaligned an amount less than one-half degree during the turn illustrated. This amount of error is negligible when it is considered that a skidder type trailer (one having non-steerable axles) exhibits an error per axle of seven degrees when the same turn is made.

During sharper turns, the turning error becomes progressively greater, for example, the error per axle of the present device being in the order of one degree when the respective axes of the tractor and trailer are disposed at an angle of forty degrees (the error per axle of the skidder type being about ten degrees under the same conditions).

Since most turns made at road speed (the time when maximum tire wear occurs) require that the tractor turn much less than thirty degrees, it will be apparent that the steering error included will be negligible insofar as its effect on handling the vehicle or on tire mileage. It is an important advantage that backing a trailer constructed in accordance with the present invention will be no more difficult than backing a single axle trailer since the steerable axle is always under the direct control of the tractor.

As previously pointed out, axle 19 moves forward (guided by movement of pin 41 in slot 42 of plate 29) when the respective axes of the tractor and the trailer are angularly displaced as when negotiating a turn. Accordingly, by limiting the length of slot 42, it is possible to limit the maximum steering movement of axle 19 and also limit the maximum displacement of the axes of the tractor and trailer. By limiting the maximum displacement between the aforesaid axes, the present construction is far safer than those heretofore employed since the instant construction prevents jack knifing of the tractor-trailer unit. A fore and aft lost motion mechanism is thus provided so that in the event of failure of the vertical axis the trailer is towed by said link means or in the event of failure of said link means both sets of wheels are towed by the frame of the trailer.

WHAT I CLAIM IS:—

1. A trailer having two sets of wheels spaced from each other with the front set of wheels mounted on an axle which is mounted in the trailer so as to be capable of both a pivotal movement and a limited longitudinal movement relative to the trailer, said axle having connected thereto on opposite sides of its pivotal mounting in the trailer the rear ends of a pair of steering rods, the forward ends of which are connectable to the tractor symmetrically on opposite sides of the vertical axis which is located at the rear end of the tractor and about which the trailer is pivotally connectable with the tractor.

2. A trailer according to claim 1 in which the rear set of wheels is connected to a rear portion of and a front set of wheels to the forward portion, of a sub frame which is oscillatable about a horizontal rock shaft provided in the main frame of the trailer, said forward portion of the sub frame being narrow so as to fit between the front set of wheels and permit displacement or adjustment of said front portion relative to said wheels.

3. A trailer according to claim 2 in which the rear portion of the sub frame has resilient connections with the rear set of wheels.

4. A trailer according to claim 2 or 3 in which the forward portion of the sub frame is flexibly connected to the front set of wheels.

5. A trailer according to claim 2 in which the sub frame consists of two independent longitudinal arms capable of oscillating independently around the horizontal rock shaft.

6. A trailer according to claim 3 in which each resilient connection is a leaf spring whose center portion is secured to the axle of the rear set of wheels, the rear end of the leaf spring being engaged with the main frame and the forward portion engaged with the rear portion of the sub frame.

7. A trailer substantially as hereinbefore described with reference to and as illustrated by the accompanying drawings.

For the Applicant.

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Chartered Patent Agents.

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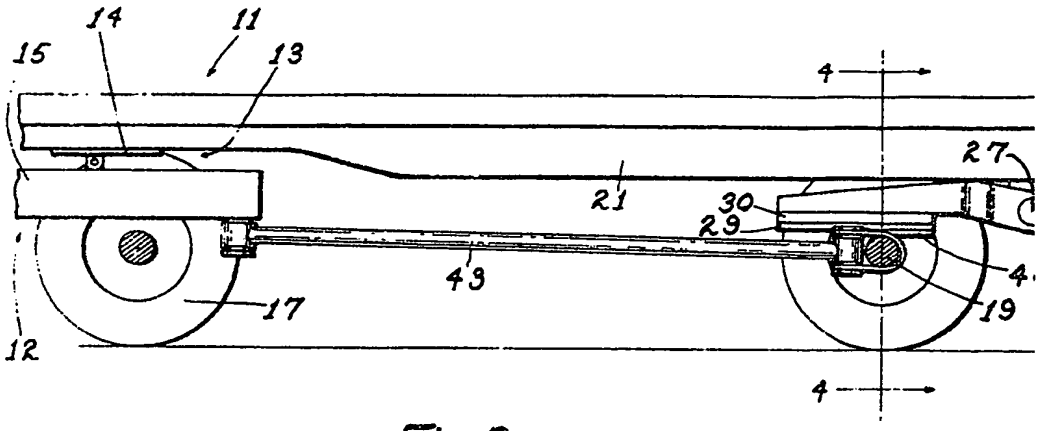
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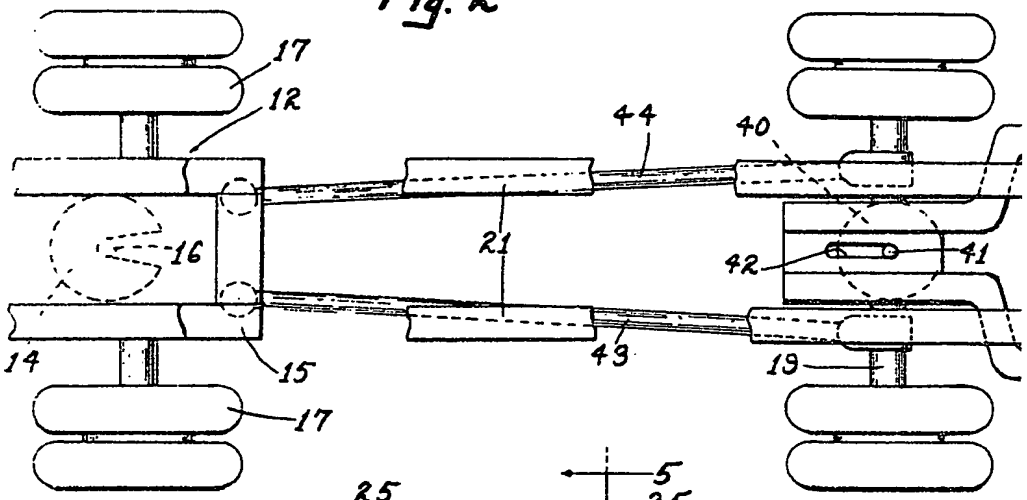
Fig. 2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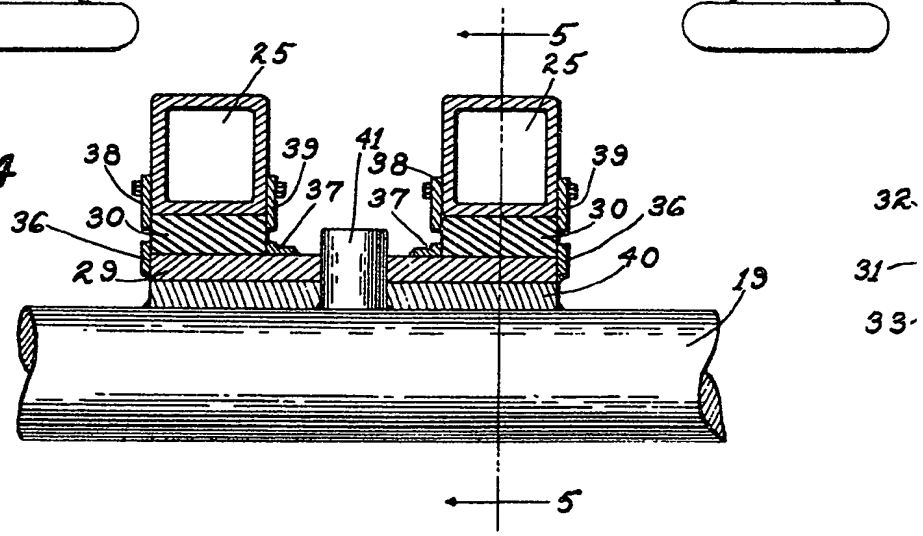
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Fig. 4

821,330 COMPLETE SPECIFICATION

2 SHEETS

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SHEET 1

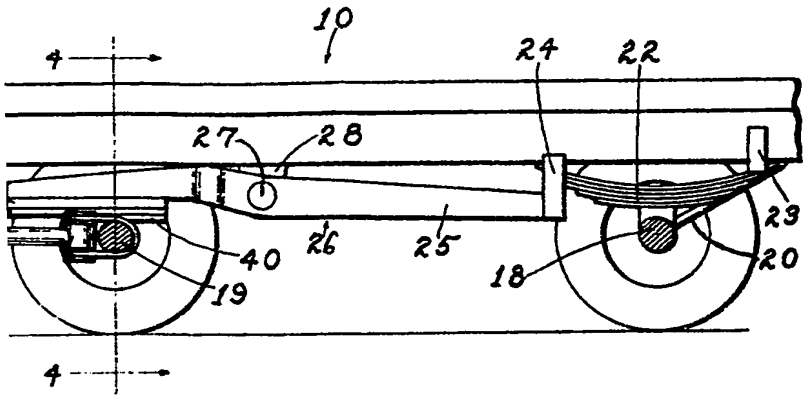
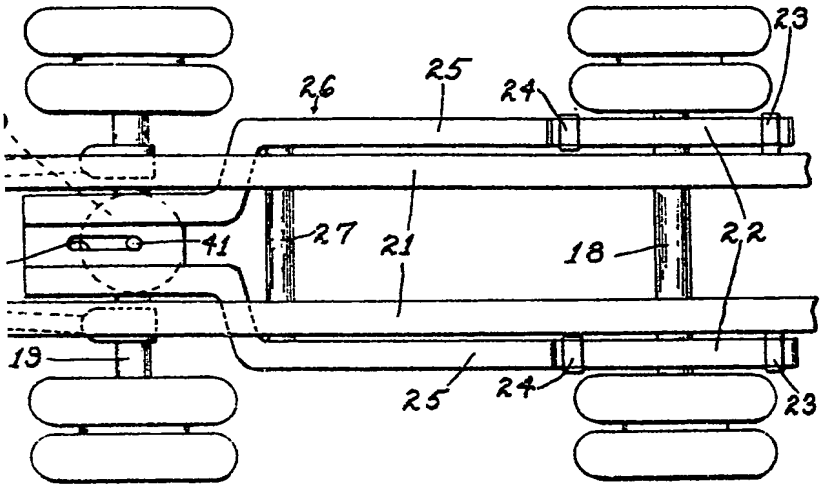


Fig. 1



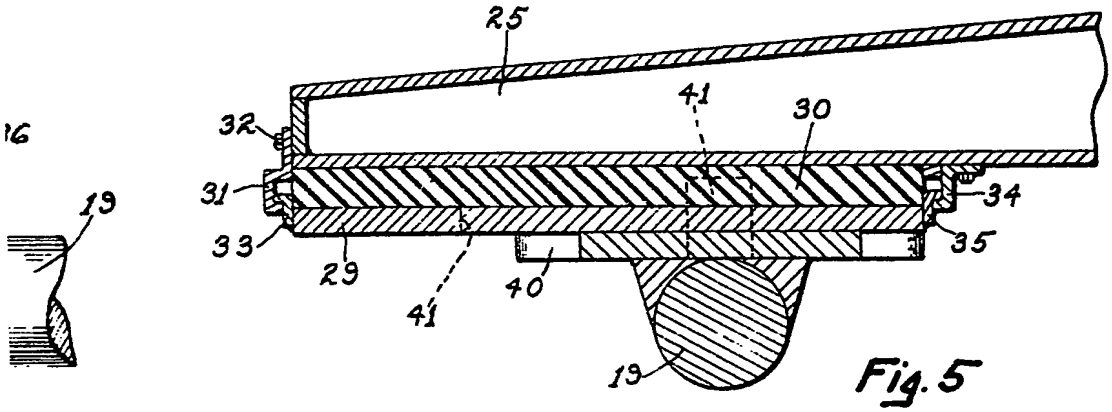


Fig. 5

821,330 COMPLETE SPECIFICATION

2 SHEETS

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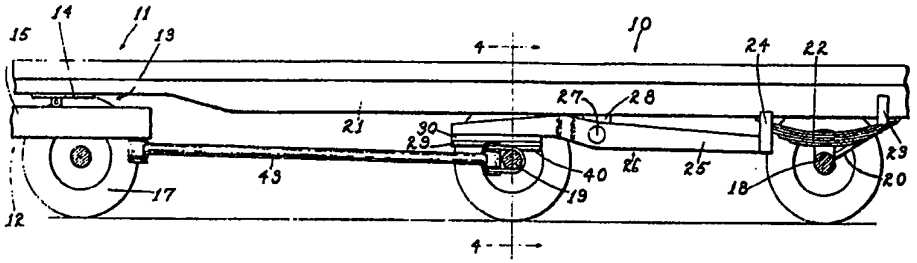


Fig. 1

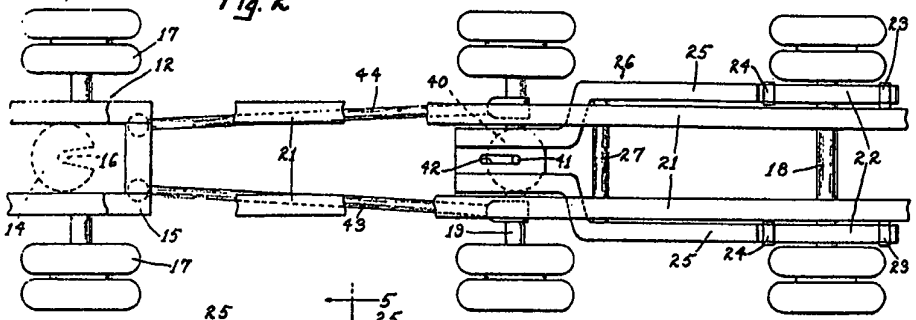


Fig. 2

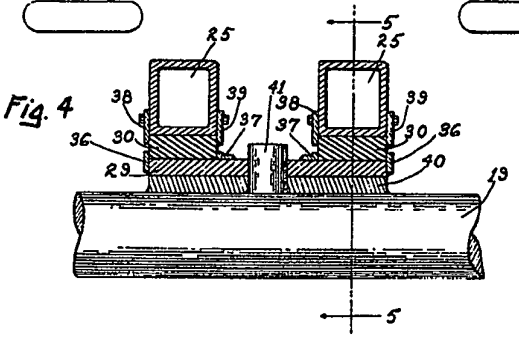


Fig. 4

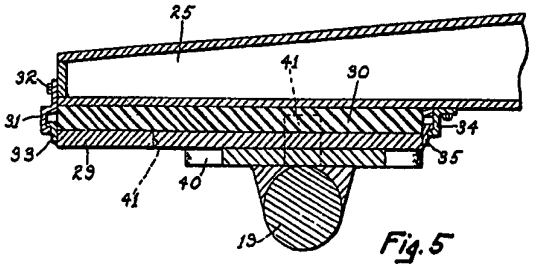
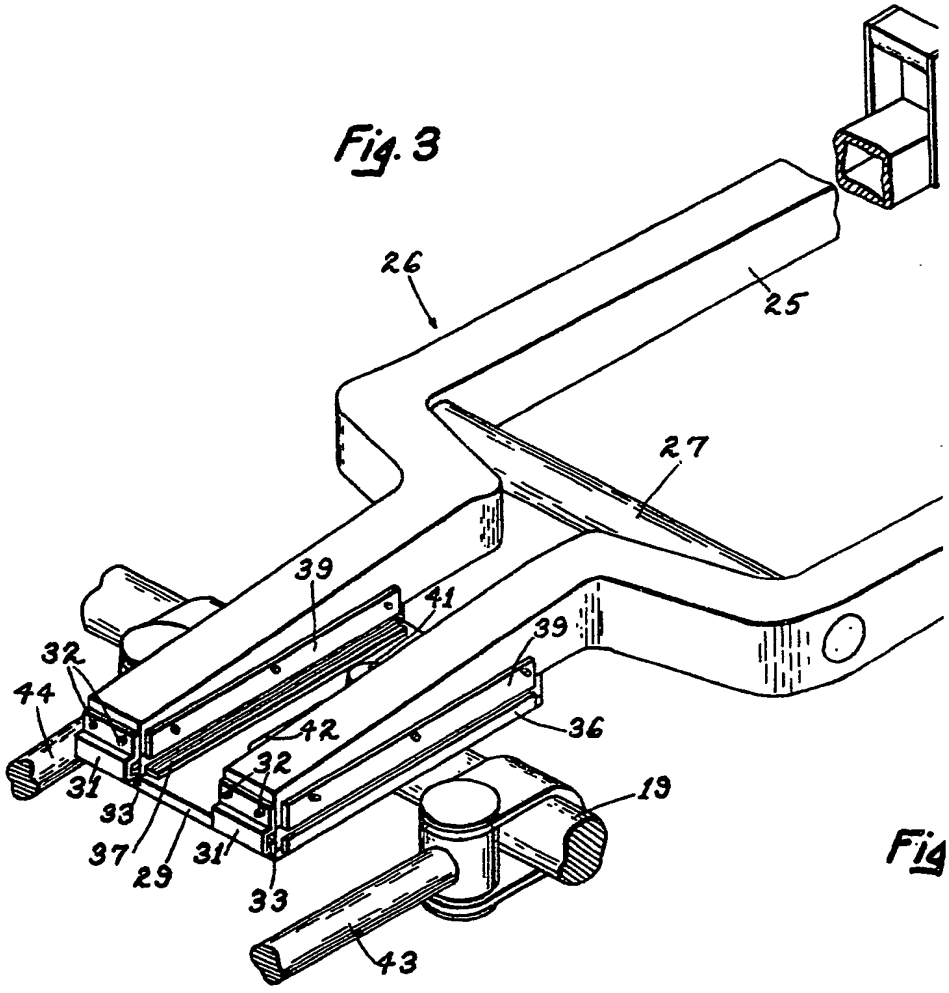
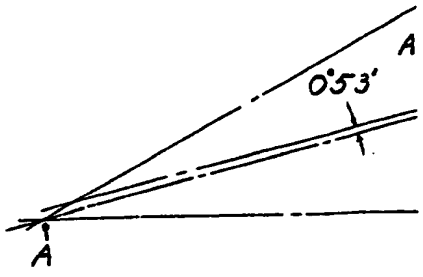


Fig. 5

Fig. 3



Fig



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SHEET 2

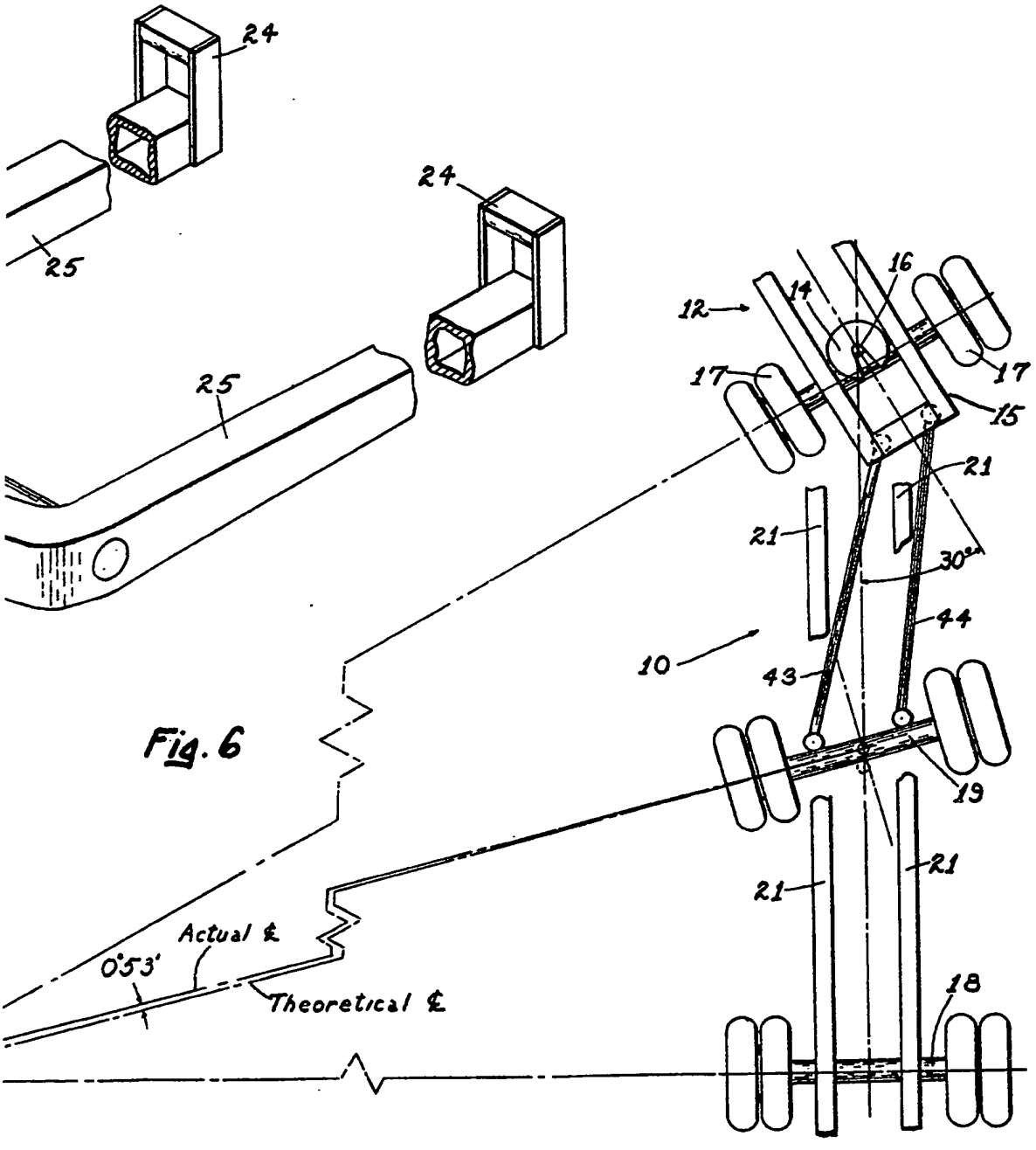

Fig. 6

821,330 COMPLETE SPECIFICATION
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SHEET 2

Fig. 3

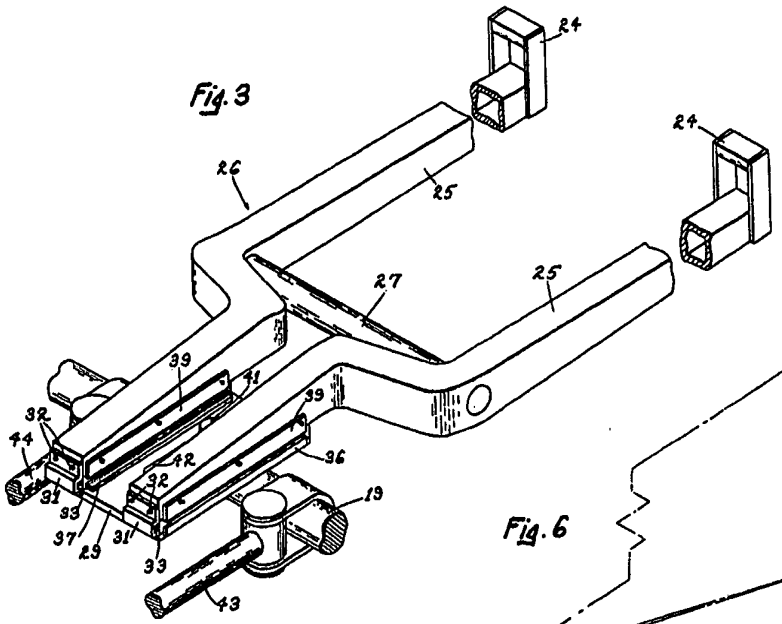

Fig. 6